

What is claimed is:

1. A liquid distillation system comprising:

- a) an input for receiving untreated liquid;
- b) an evaporator coupled to the input for transforming the liquid to vapor;
- c) a head chamber for collecting vapor from the evaporator;
- d) a liquid ring pump comprising:
  - i. an internal drive shaft; and
  - ii. an eccentric rotor with a rotatable housing;
- e) an electric motor having a motor rotor and motor magnets to power the drive shaft wherein the motor rotor and magnets are hermetically sealed within a liquid fluid pressure boundary of the liquid ring pump;
- f) a condenser in communication with the liquid ring pump for transforming compressed vapor into a distilled liquid product;
- g) an output for discharging of distilled liquid product;
- h) a liquid waste output; and
- i) a sump wherein liquid from the evaporator may be preheated at start-up, wherein the evaporator has a plurality of parallel evaporator tubes, each tube having a first open end in communication with the sump and a second open end in communication with the head chamber and wherein each of the plurality of parallel tubes is sealed at the first end and second end by an elastomer tube seal.

2. The liquid distillation system as in claim 1 wherein the rotor further comprises a multiplicity of vanes separated by chambers, each chamber having an intake and an exit.

3. A liquid distillation system according to claim 1 wherein the input is coupled to at least one heat source.

6. A liquid distillation system according to claim 1 further comprising a regulator for maintaining a liquid level sufficient to permit purification of liquid from the evaporator tubes and damping of local turbulence.
7. A liquid distillation system according to claim 1, the system further comprising a regulator for maintaining and controlling pressure in the condenser.
8. A liquid distillation system according to claim 1 wherein the output for collection of distilled liquid product is further in connection with the input for recycling a blowdown stream.
9. A liquid distillation system according to claim 1 further comprising a pre-treatment assembly coupled to the input.
10. A liquid distillation system according to claim 1, the system further comprising a heating unit for heating input liquid upon startup.
11. A liquid distillation system according to claim 1 further comprising a heat exchanger for receiving liquid from the input such that heat from at least one source is exchanged with the input liquid.
12. A liquid distillation system according to claim 11 wherein the at least one heat source is selected from the group consisting of a product stream, a blowdown stream, system waste heat, liquid ring pump waste heat, motor waste heat, exhaust heat from a power source, and an external heat source.
13. A liquid distillation system according to claim 1 wherein the electric motor is a permanent magnet brushless motor.
14. A liquid distillation system according to claim 1 further comprising a power source

coupled to the system wherein the power source is a clean-burning generator.

15. A liquid distillation according to claim 1, further comprising a siphon pump to pump liquid into the vapor pump from a reservoir.

37. A liquid distillation system according to claim 1, wherein the condenser and the evaporator are in thermal contact.

38. A liquid distillation system according to claim 37, wherein the condenser has a surface with a hydrophobic coating, the surface in contact with compressed vapor and liquid.

41. A liquid distillation system comprising:

- a) an input for receiving untreated liquid;
- b) an evaporator coupled to the input for transforming the liquid to vapor;
- c) a head chamber for collecting vapor from the evaporator;
- d) a liquid ring pump comprising:
  - i. an internal drive shaft;
  - ii. an eccentric rotor with a rotatable housing;
- e) an electric motor having a motor rotor and motor magnets to power the drive shaft wherein the motor rotor and magnets are hermetically sealed within a liquid fluid pressure boundary of the liquid ring pump;
- f) a condenser in communication with the liquid ring pump for transforming compressed vapor into a distilled liquid product;
- g) an output for discharging of distilled liquid product;
- h) a liquid waste output; and
- i) a fluid distribution manifold having flow regulation, mist removal, and pressure regulation in a single unit,

wherein the evaporator has a plurality of parallel core layers with rib sections that create channels for directing steam and condensed liquid flow, and wherein alternating parallel core layers comprise an evaporator channel and a condenser channel such that evaporation and condensation are separated.

42. A liquid distillation system according to claim 41, wherein core plates and manifolding are made of material selected from the group consisting of plastic, metal, ceramic, and non-corrosive material capable of withstanding high temperature and pressure.

## **Pressurized Vapor Cycle Liquid Distillation**

### **Abstract**

Embodiments of the invention are directed toward a novel pressurized vapor cycle for distilling liquids. In an embodiment of the invention, a liquid purification system is revealed, including the elements of an input for receiving untreated liquid, a vaporizer coupled to the input for transforming the liquid to vapor, a head chamber for collecting the vapor, a vapor pump with an internal drive shaft and an eccentric rotor with a rotatable housing for compressing vapor, a condenser in communication with the vapor pump for transforming the compressed vapor into a distilled product, and an electric motor with motor rotor and magnets hermetically sealed within the fluid pressure boundary of the distillation system.